International Journal of Mining Science (IJMS)
Volume 4, Issue 4, 2018, PP 38-43
ISSN 2454-9460 (Online)
DOI: http://dx.doi.org/10.20431/2454-9460.0404004
www.arcjournals.org

Assessment for Artisanal Gold Mining Impacts on Vegetation Ecology at Shire Districts, Tigray-Ethiopia

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Abstract: *Ethiopia is one of the countries that are making efforts to formalize the ASM (artisanal gold mining) sector by licensing individual miners, providing technical support for capacity building, and setting up basic infrastructure and facilitating formalized marketing of gold. The study area was in hectare where most the active mining and ecological land use and land cover were revealed. Because of this mining indigenous plants are degraded. Along the mining adjacent (rescued near to mining site), there was many indicator plants as the area is rich in various plant species. The present study was investigate on the spot that ecological impacts such deforestation, siltation, formation of trench and pits, top soil removal, water pollution and veldt fires were more significant. The government should enforcers the laws and regulations and promoter of mining development side by side putting ecological impacts mitigation measurements with stakeholders. Governments should enhance paying attention in supporting to financial resources and more incentives for conservation damaged ecosystems and create awareness and enforcing rules to create a healthy, sustainable and productive environment.*

Keywords: *Ethiopia, Artisanal Mining, Plant, Ecological Impacts, Conservation*

1. INTRODUCTION

1.1. Background of the Study

The impact of mining on environmental includes erosion, formation of sinkholes, loss of biodiversity, and contamination of soil, groundwater and surface water by chemicals from mining processes. In some cases, additional forest logging is done in the vicinity of mines to increase the gold volume for the sick and room for the storage of the created debris and soil. Besides creating environmental damage, the contamination resulting from leakage of chemicals also affects the health of the local population. Mining companies in some countries are required to follow environmental and rehabilitation codes (re-vegetation), ensuring the area mined is returned close to its original state. Some mining methods may have significant environmental and public health effects [4].

Destruction of the habitat is the main component of plant biodiversity losses, but direct poisoning caused by mine-extracted material and indirect poisoning through food and water, can also affect animals, vegetation and microorganisms. Habitat modification such as pH and temperature modification disturb communities in the area. Endemic species are especially sensitive, since they need very specific environmental conditions. Destruction or slight modification of their habitat puts them at the risk of extinction [10]. Soils' texture and water content can be greatly modified in disturbed sites, leading to plants communities changes in the area. Most of the plants have a low concentration tolerance for metals in the soil, but sensitivity differs among species. Grass diversity and total cover is less affected by high contaminant concentration than forbs and shrubs. Mines waste-material rejects or traces due to mining activity can be found in the vicinity of the mine, sometimes pretty far away from the source. Established plants cannot move away from perturbations, and will eventually die if their habitat is contaminated by heavy metals or metalloids at concentration too elevated for their physiology [5]

Mining is important to the economy of Ethiopia as a diversification from agriculture. Currently, mining comprises only 1% of GDP. Gold, gemstones (diamonds and sapphires), and industrial

minerals are important commodities for the country's export-oriented growth strategy [2].Tantalum mining has also been profitable. It was reported that in the late 1980s, the mineral industry lacked importance given that it contributed less than 0.2 percent of Ethiopia's GDP. Mining for gold is a key development sector in the country. Gold export, which was just US$5 million in 2001, has recorded a large increase to US$602 million in 2012 [2, 8].

The Ethiopian Geological Survey of the Ministry of Mines and Energy with assistance from UNDP and private companies has assessed the mineral and petroleum resources of Ethiopia. The resources discovered in different regions of the country are mainly gold, tantalum, phosphorus, iron, salt, potash, soda ash, gemstones, coal, geothermal and natural gas, apart from many industrial and construction materials. According to the current situation happening in the country, unless mining environmental impact assessment is not done, the mining activities destroys landscapes, forests and wildlife habitats at the site of the mine when trees, plants, and topsoil are cleared from the mining area. This in turn leads to habitat lose/degradation, ecological contamination, cause climate change, soil erosion and destruction of agricultural land [9]. Even though artisanal gold mining and small scale artisanal gold mining are common over all of the country, only few companies are enter to the modern gold mining until recent time. Gold mining company's annually reports the environmental management plan and environmental impacts assessments [2, 6]. Mining companies' activities such as releasing chemicals and wastes, site preparation, transporting, trenching, housing (recruitment around the mining site)etc are strongly affect for the surviving of plant and losses/degrades their natural ecosystem/habitat. Though, no well-studied data base is present in Ethiopia on this topic, this study were conducted to fill the existing study gab on the impacts of gold mining on ecology [3].

Accordingly the study were involved the following objectives;

2. Objectives Of The Study

2.1.Major Objective

To assess of the major impacts on gold mining vegetation ecology in shire district

2.2.Specific Objective

- To determine the impacts of artisanal gold mining on vegetation.
- To assess the ecological aspects which are affected during mining activities
- To explore the mitigation measures for the impacts of gold mining associate with ecology in the stud area.

2.3.Significance of the Study

Assessment of ecological impacts associated with gold panning is critical to decision-making, planning and implementation of development projects that are competing for the same resources in the district legal mining, illegal gold mining and subsistence irrigated agriculture. Even though plant ecosystem affect by different causes have been studied in various aspects in the country, there is no more study on the impacts of mining activities associate with Ecology. Therefore this study provide preliminary information on this topic for the next study as well as important to the local community, government, policy makers and impact managers in that it provides a step towards good land management practices that are crucial in sustainable resources. Further it gives a clue on how to assess, conserve, mitigate and rehabilitate to the treated local ecosystem due to artisanal gold mining.

3. Materials And Method

3.1. The Study Area

Shire is found in north western tigray, Ethiopia Geographically located b/n 14^{0}06'.22.65''North latitude & 38^{0}02.18'65" East longitude at altitude of 1924masl. In the district there are different artisanal gold mining is highly performed. The present study was conducted in Laelay Adyabo (Adinigsti site) which is one of the districts where high artisanal mining were piloted. In the mining site degraded vegetation were revealed, however in the adjacent of the mining site tightly vegetation community were observed. Along the adjacent of the river many riverine plants were situate.

Figure1. *Map of the study area*

3.2. Materials

Topographic maps published relevant reports and maps, books, journals and literatures will used as reference material. Equipment like digital photo camera, Meter, GPS (Global Positioning System), plant press was used during field survey.

3.3. Data Collection

3.3.1. Primary Data Collection

Field works such as physical observation, vegetation sampling, ecological information of the plant diversity; direct taking of photograph were conducted to get actual data for the impact of assessment of gold mining on plant biodiversity in the study area.

3.3.2. Secondary Data Collection

To assess the general impact of the gold mining on plant biodiversity, Secondary data sources such as background information, Topography map of the study area, reviewed literatures and other important information relevant to study will be collected.

3.4. Data Analysis

The satellite images were processed using Arc GIS software. Data collected through questionnaires, interviews and group discussion will be analyzed by tallying the information obtained and evaluating the proportion of respondent on each datum collected from the mincers and company's environmental staff. On the other hand ecological information collected on plant diversity was evaluated using density, abundance and frequency ratios based on sampled survey. Ecological impacts such as deforestation, Veld Fires, Land Degradation, Siltation, Open pits formation, land degradation, desertification and trenching were analyzed and ranked based on the impact they formed.

4. Result And Discussion

4.1. Major Plants Identified in the Study Area

Ethiopia is one of the biodiversity richest parts of the world and it is estimated to contain nearly 7,000 species of higher plants, of which about 12% are endemic. The vegetation types with the highest portion of endemics are the woodlands, followed by the Afroalpine and Sub-afroalpine. Ethiopia is the center of origin for various 119 crop species including Arabica coffee, teff, enset (Ensete ventricosum) and sorghum in part (State of the Environment Report for Ethiopia – August 2003).Even less dense vegetation exists in the study area, trees, shrubs, and herbs are common (Refer to table 1 below). But the plants are under eradication because of poor ecological management and rehabilitation via refilling and replanting the study mining area.

Table1. *Plant species collected from the study area*

S. No.	Tigrigna Name/ Vernacular Name	*Species/Botanical Name*	*Family Name*	Habit
1.	Chigono	*Albiziaamara*	Fabaceae	Tree
2.	Aye	*Mimisops kummel*	Sapotaceae	Tree
3.	Gomero	*A. polycantha*	Fabaceae	Tree
4.	Hanse	*Anogeissusleiocarpa*	Combretaceae	Tree
5.	Miliao/enkoy	*Ximeniaamericacna*	Olaccaceae	Tree
6.	Liham	*Syzygiumguineense*	Myrtaceae	Tree
7.	Tahises/kitkita	*DodonaeaAngustifolia*	Sapindaceae	Tree
8.	Chea/ Bazragrar	*Acacia tortilis*	Leguminosae	Tree
9.	Momona	*Faidherbiaalbida*	Leguminoceae	Tree
10.	Awihi/wanza	*Cordia Africana*	Boraginaceae	Tree
11.	Tambuk	*Croton macrostachys*	Euphorbiaceae	Tree
12.	Gaba/Geba/*Qurkura*	*Ziziphusspina-christi*	Rhamnceae	Tree
13.	Sagila/ Shola	*Ficussycomorus*	Moraceae	Tree
14.	Kermed	*Capparistomentosa*	Capparidaceae	Tree
15.	Kiliaw/dedeho	*Euclearacemosa*	Ebenaceae	Tree
16.	Mekie	*Balanitesaegyptica*	Balanitaceae	Tree
17.	Gonnok/Kenay	*Dichrostachyscinerea*	Leguminosae	Tree
18.	Kinichib	*Euphorbia tirucalli*	Euphorbiaceae	Shrub/Tree
19.	Eika	*Agave americana*	Agavaceae	Shrub
20.	Atiat/tselimoy	*Maytenusarbutifolia*	Celastraceae	Shrub
21.	Hambihambo	*Sennasingueana*	Fabaceae	Shrub
22.	Lahay	*Acacia lahai*	Fabaceae	Tree
23.	Keniteb	*Acacia mellifera*	Fabaceae	shrub
24.	A'lqe	*Cyphostemmaniyeum*	Vitaceae	Climber
25.	Habbi -tselim	*Jasminumgrandiflorum*	Oleaceae	Climber
26.	Chieindog	*Otostegiaintegrifolia*	Lamiaceae	Shrub
27.	Mewitei/Mebtie	*Acokantheraschimperi*	Apocynaceae	Tree
28.	Teta'alo	*Rhusglutinosa*	Anacardiaceae	shrub
29.	Alendia	*Ormocarpumpubescens*	Fabaceae	Shrub
30.	Zanzay	*Ozoroainsignis*	Anacardiaceae	Tree
31.	Shbaka/seqante	*Ficusthonningii*	Moraceae	Tree
32.	Adi-zana/ Adigi -zana	*Stereospermumkunthianum*	Bignoniaceae	Tree
33.	Terae/hareg/	*Clematis simensis*	Ranunculaceae	Climber
34.	Chie'ndog	*Otostegiaintegrifalia*	Lamiceae	shrub
35.	Mirikuzzibe	*Bersamaabyssinica*	Melianthaceae	shrub
36.	Meseqa	*Grewiaferruginea*	Tiliaceae	Shrub/tree
37.	GabaAdgi/GebaAdgi	*Ziziphusabyssinicus*	-	tree
38.	Keryah	-	-	shrub
39.	Hatsinay	*Gardenia temifolia*	Rubiaceae	tree
40.	Tikurberber	*Schinusmolle L.*	anacardiaceae	tree
41.	Awli'e	*Oleaeuropeae*	Oleaceae	tree
42.	Qolqal	*Euphorbia abyssinica*	Euphorbiaceae	tree

4.2. Major Potential Ecological Impacts of Mining

Obviously, any mining activities have ecological (environmental) hazards. Even local peoples enjoy on artisanal mining have a good experience and awareness the ecological impacts of mining with insufficient practices how to mitigate it and its post mining impact [1,7]. The study area (Adinigsti) was estimated 420 hectare which actively mining performed. Both parties were issued with questionnaires requesting them to identify and list the ecological problems, specific hazards and the elements affected by the hazards. In the same vein interviews also sought out to identify if the same themes could be raised. The area is acacia comiphora vegetation types with some *Combretum* and T*erminalia* species were commonly revealed. Plant families such as Fabaceae, Moraceae, Sapotaceae Boraginaceae, Euphorbiaceae and Anacardiaceae are dominant in the study area. Observations show the gravity of these ecological disasters (such as deforestation, siltation, formation of trench and pits, top soil removal, water pollution and veldt fires) whilst existing evidence on the capacities of water, dams now hold clearly indicate the small portion of space occupied by the reservoirs. The ecological

impacts artisanal mining in relative their potential is described each other were analyzed in the Table 2. Deforestation, Siltation, Formation of trench and pits, Top soil removal, Water pollution, Veldt fires, Land degradation and chemical releasing are the major impacts for the study area. To make free and appropriate the mining area, miners are release veldt fires to the afforested area. In addition, since miners are come from outside the local kebele, they make a temporal residence around the mining area. This imposes to devastate vegetation resources and devastating the vegetation ecosystem.

Table2. *Potential ecological impacts Artisanal small scaled mining in Adinigsti in the study area*

SN	Existed ecological impacts	Magnitude of the impact(magnitude affected area/total area: in hectare)
1	Deforestation	Medium(200/420)
2	Siltation	High(264/420)
3	Formation of trench and pits	High(228/420)
4	Top soil removal	High(273/420)
5	Water pollution	Very high(70%mixuture of particles)
6	Veldt fires	Medium(176/420)
7	Land degradation	Very high(325/420)
8	Chemical releasing	Low(0.2 con/ml)

Panning were mostly implemented around the watershed, hence land degradation around the water body, water pollution and siltation were extremely high. In addition the due to poor lange management practice soil was exposed to removal by heavy rain and wind. Near to the water body since high mining s conducting there, deforestation was high in compare to the far adjacent vegetation community. Though the amount mercury analyzed from soil and water sample reveals the presence of mercury released from the panners it were to negligible as compares with other ecological impacts. However the attribute of mercury is dangerous even in small amount for the environment's biotic and abiotic comments.

5. CONCLUSION

This study was intended to assess the major ecological impacts of artisanal mining in Shire district, Adinigsti locality. In the area there were many vegetation extended from large trees and small herbs. Anthropogenic impacts such as mining and fire are the major impacts for the local vegetation ecology. Environmental elements under threat as water, land, soil are non-renewable economic resources that man depends on for survival. Thus for man to continue enjoying these benefits sustainable means of exploitation are crucial. It emerged from the research that stopping artisanal gold mining at the moment is not a viable solution since people are being forced into the activity mainly by lack of employment, drought and general poverty affecting the whole country. Panners are highly triggering to form land degradation, water pollution, soil siltation and vegetation degradation due to improper mining activities. In addition pit formation and chemical (Mercury) releasing to the ecosystem leads, various physical damage both to life and environment. On the spot these ecological impacts was reveal extensively and reach in series status (see figure 2)

Figure2. *Different ecological impacts artisanal mining in the study area*

RECOMMENDATION

It is clear that artisanal small scale gold mining in Shire district poses a serious threat to the ecology which in turn jeopardizes human lives and their livelihoods if the problem remains unabated. The flowing effects of veld fires, land degradation, and water pollution may appear insignificant to some populations, but are real and their cumulative effect needs to be mitigated to reduce their impact on Adinigisti district and the shire-Tigray, community as a whole. The government and Shire community therefore needs to come up with strategies that seek to reduce destruction of the ecological system. Such strategies as discussed below include policing, penalties, taxes, provision of mining licenses at affordable fees, equipment, training and environmental awareness campaigns and education to both informal and formal small scale gold miners, rehabilitation and compensation for the ecologically degraded and affected mining site is recommended in collaboration the local community and decision makers. In addition, participant center ecological management enables to overcome the problem situated by boosting the local community sense of ownership and beneficiary.

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Citation: *Mehari Girmay, (2018)" Assessment for Artisanal Gold Mining Impacts on Vegetation Ecology at Shire Districts, Tigray-Ethiopia", Southeast Cameroon, International Journal of Mining Science (IJMS), 4(4), pp.38-43, DOI: http://dx.doi.org/10.20431/2454-9460.0404004*